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(71) Applicant
Komet Stahlhalter- und Werkzeugfabrik Robert Breuning GmbH
Auf dem Kies 3
D-7122 Besigheim
Federal Repulic of Germany
(72) Inventor
Otto Eckle
(74) Agents
Reddie & Grose

(54) Drilling tool for drilling holes in solid metal workpieces

(57) In a drilling tool for drilling holes in solid metal, at least two cutting inserts 3, 13 are arranged exchangeably in recesses at the front of the drill shank. The polygonal cutting inserts each have a plurality of cutting edges of equal length, of which at least one is in contact with the workpiece in each case. In order to achieve equal wear of the cutting edges of both cutting inerts 3, 13, the latter are of different sizes, the outer cutting corners 3*c* and 13*c* of the cutting inserts 3 and 13 respectively being at the same distance from the axis M of the drill 1. One cutting edge 3*a* of the larger cutting insert 3 is immediately adjacent or extends across the axis M of the drill 1.

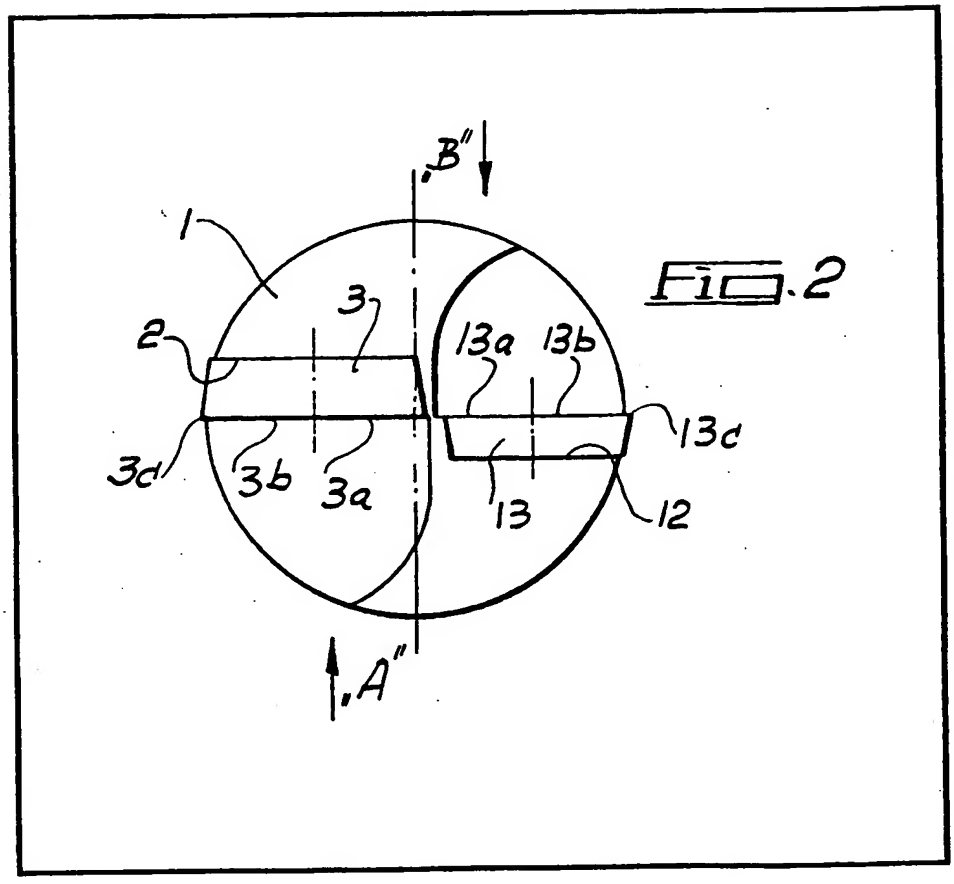

Fig.2

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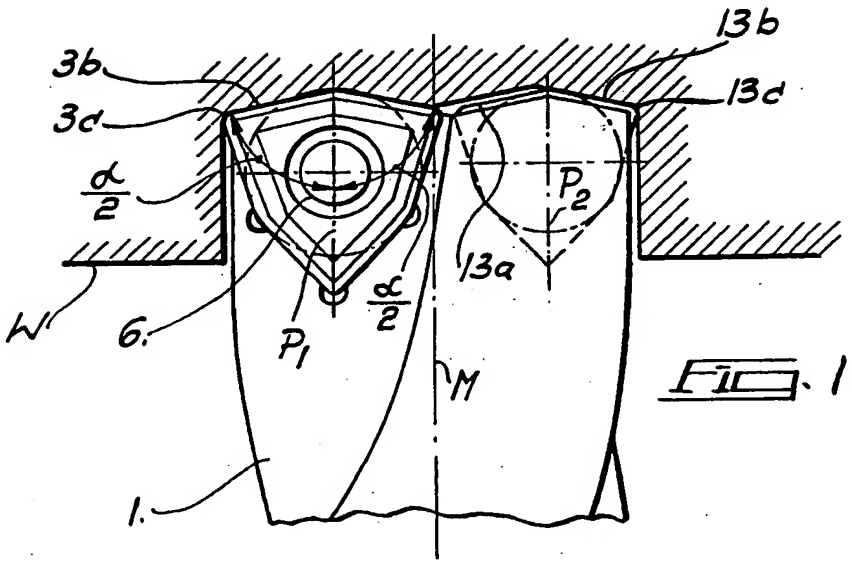


FIG. 1

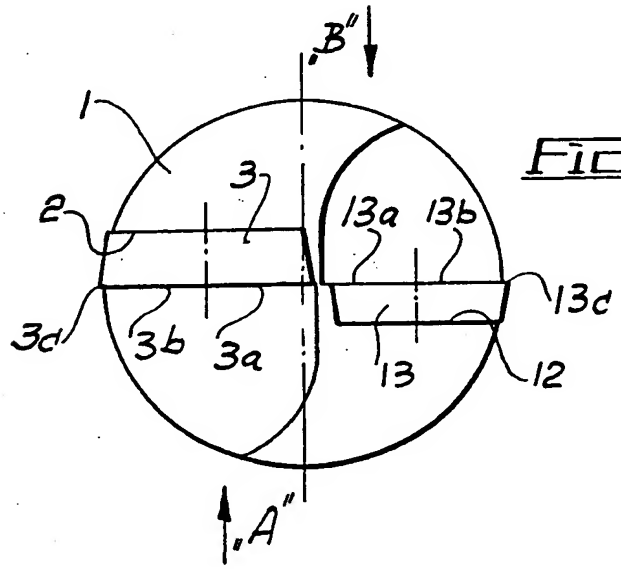


FIG. 2

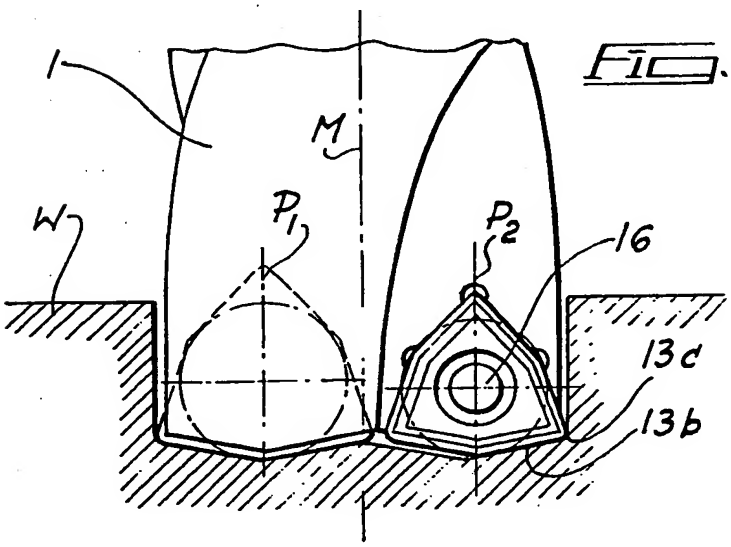


FIG. 3

FIG. 4

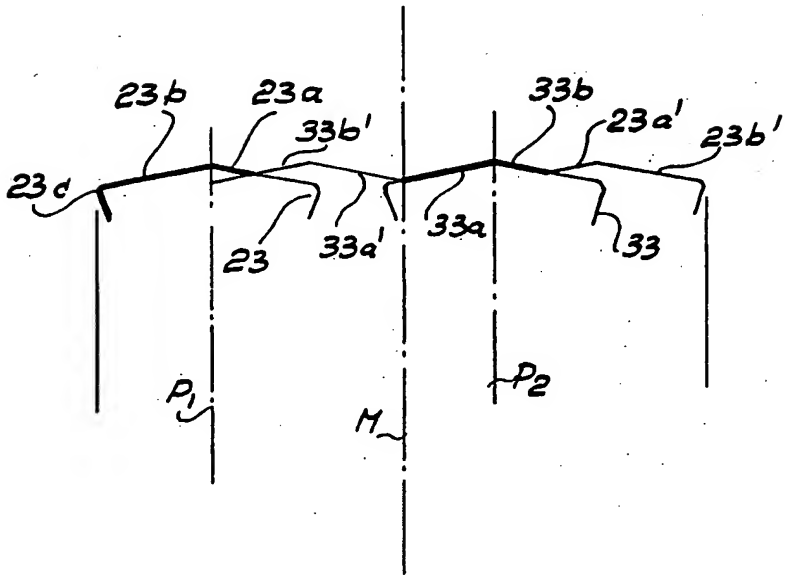
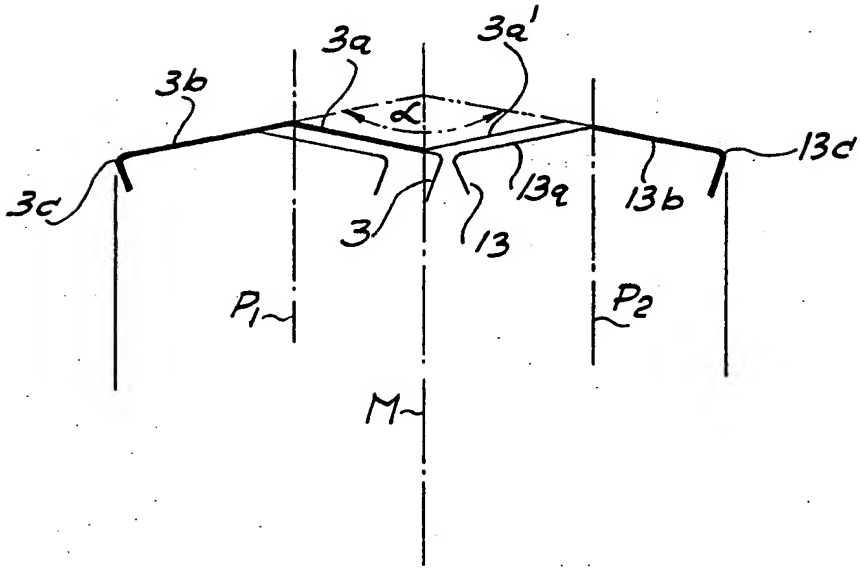


FIG. 5



SPECIFICATION

Drilling tool for drilling holes in solid metal workpieces

The invention relates to a drilling tool for drilling holes in solid metal workpieces and of the kind comprising a shank and at least two exchangeable cutting inserts arranged in a recess at the front of the shank and each having a plurality of cutting edges of equal length, the cutting edge of at least one cutting insert being immediately adjacent the axis of the drill or extending slightly beyond it.

Such drilling tools are known, for example, from German Laid-open Pending Patent Application 2610292 and U.S. Patent Specification 3,540,323. The drilling tools with insertable cutting sets described therein are so designed that, depending on the hole or bore diameter, either one or two or even more cutting inserts is or are employed.

In the case of drills with only one cutting insert, the zone of shaving removal extends from a cutting corner or angle which is in the outermost position, where the cutting speed is greatest, to the drill axis, where the cutting speed becomes zero.

In the case of larger known drilling tools of the kind mentioned at the beginning, two cutting inserts are so arranged as a rule that one is located on a larger radius and works the diameter of the hole by means of an outermost cutting corner, the adjacent cutting edge, however, not extending back as far as the central axis. In contrast, the cutting edge of the second cutting insert, which is of the same size, reaches or extends beyond the drill axis and is consequently arranged on a smaller radius compared with the first cutting insert. Consequently, the second cutting insert does not reach the outer diameter of the hole with its outer cutting corner.

The cutting speed is greatest in these double-equipped drilling tools at the furthest-reaching cutting corner of the first cutting insert and is equal to zero where the second cutting insert extends beyond the central axis with its cutting edge.

Accordingly, in both types of drill, the wear is greatest as a rule at the outermost cutting corner and, consequently, the life of these cutting corners is shortest. This unequal cutting-edge wear results in limited economy. Furthermore, the outer cutting insert of a two insert drill must be turned or replaced more often than the inner cutting insert. If the cutting inserts are exchanged at the same time, they are frequently not yet completely worn out. If they are not exchanged at the same time, however, additional stoppage times and reduced economy are the result.

The object of the invention, therefore, is to provide a drilling tool of the kind mentioned at the beginning such that the wear of the cutting edges is equalized and the economy of the drilling is thereby substantially improved.

According to the invention, this is achieved in that at least two cutting inserts of different sizes are so arranged on the shank that their outer cutting corners are located at the same distance from the central axis.

The drilling tool according to the invention consequently has the special advantage that joint working of a hole by two contour or outline cutting edges at the same time takes place, a joint circular working of the hole also taking place at least in the partial zone of the lateral length of the smaller cutting insert, so that this zone, which moreover has a comparatively high cutting speed, also has a shared stress. It is true that the zone which then follows on as far as the drill axis is only worked by the partial cutting edge of the larger cutting insert, but this is also the zone in which the cutting speed, and consequently the degree of wear, is substantially lower.

Due to the simultaneous working of the hole by means of two diametrically opposite cutting corners, lateral drift of the drill is moreover substantially reduced in comparison with arrangements known heretofore. There is already a certain guidance of direction on commencement of drilling and, due to the combination of the operative cutting-edge sections, the drill preserves a comparatively steady equalization of cutting pressure, especially when the participation of the individual cutting-edge sections in the cross-section of the shavings is so arranged by light axial shifting of the two cutting inserts with respect to one another that a comparatively good cutting-force symmetry is produced.

The invention will now be described in more detail, solely by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a longitudinal section through a workpiece showing an embodiment of the drilling tool according to the invention,

Figure 2 is a plan view of the drilling tool according to Fig. 1,

Figure 3 is a side view of the drilling tool according to Figs. 1 and 2 in section in the direction of the arrow "B",

Figure 4 is a diagrammatic sectional representation of the drilling location of a known drilling tool, and

Figure 5 is a diagrammatic sectional representation of the drilling location when a drilling tool accoring to Figs. 1 to 3 is employed.

In the embodiment shown in Fig. 1, the shank 1 of the drilling tool has recesses 2 and 12 (Fig. 2) for receiving hexagonal cutting inserts 3 and 13, respectively, of hard metal. Coolant can be supplied to the front face of the tool via a coolant bore (not shown). The drilling tool may be arranged to be stationary and the workpiece W may be arranged to rotate or vice versa.

The two cutting inserts 3 and 13 are of different sizes and fit into their recesses 2 and 12, respectively.

Although more than two cutting inserts may also be used, two opposite cutting inserts are provided in this preferred embodiment. The larger cutting insert 3 extends from the edge of the hole or bore as far as the drilling axis M or preferably a little beyond it. The central axis of the hole drilled coincides with the axis M. The two particular front cutting edges 3*a* and 3*b* of the insert 3 are in contact, like the cutting corner 3*c*, with the material of the workpiece. The two front cutting edges 3*a* and 3*b* each form an angle of $\alpha/2$ with a line P_1 parallel to the drilling axis. The angle $\alpha/2$ is between 60° and 85°. In a preferred embodiment, the angle $\alpha = 156°$, with possible deviations of plus or minus 10°.

The cutting insert 3 may be fixed in the recess 2 in known manner, for example by means of a screw 6. After undoing the screw 6, the cutting insert can be removed and turned round through 120°, so that two fresh cutting edges then come into use.

The cutting insert 13 is preferably geometrically similar to the cutting insert 3, but smaller in its dimensions, in addition, its fixing point (for example, a screw 16), which is located on a line P_2 parallel to the drilling axis M, is further from this axis than is the fixing point of the cutting insert 3. As is apparent from Figs. 2 and 3, the cutting corner 13*c* is at the same distance from the drilling axis M as the cutting corner 3*c*. Only the cutting edge 13*b* of the cutting insert 13 is in contact with the material, however, while the cutting edge 13*a* runs free.

As can be seen from Fig. 4, in the drilling action of a known drilling tool, only one cutting corner 23*c* acts on the outer diameter of the hole. In addition, the outer part of the hole is worked merely by the whole cutting edge 23*b* and part of the cutting edge 23*a*. It has been found that, by reason of the high cutting speed, the cutting corner 23*c* and the cutting edge 23*b* are subjected to special stresses and thereby also to special wear. The cutting edge 23*a* does not extend as far as the centre line M of the hole. The region immediately about the line M is worked by the second cutting insert 33, which is of the same size as the first cutting insert 23, but mounted closer to the drilling axis which coincides with the line M, its cutting edge 33*a* extending beyond the drilling axis. The cutting edges 33*a* and 33*b* consequently work the inner zone, which is obtained as 33*a*, 33*b*, 33*a*′ and 33*b*′, while the cutting edges 23*a* and 23*b* work the outer zone 23*b*, 23*a*, 23*b*′ and 23*a*′. In addition to the detrimental unequal wear of the cutting inserts, there is also a certain drift of direction by reason of unidirectional forces.

Fig. 5 shows clearly the advantages of the embodiment which employs the larger cutting insert 3 and the smaller cutting insert 13. The cutting corners 3*c* and 13*c* and the cutting edges 3*b* and 13*b* assist each other, while the cutting edge 3*a* removes the inner zone. The extensions of the cutting edges 3*b* and 13*b* form a common shallow cone with a cone angle α' of beween 120° and 170°, preferably 156° with possible deviations by ± 10°.

Moreover, a particular advantage of the invention, as indicated by the different thickness of the lines of the cutting edges 3*b* and 13*b* in Fig. 5, is that the shaving removal cross-section for a corresponding outer length of the cutting edge 3*b* is made equal to that of the cutting edge 13*b* by the two cutting inserts being staggered slightly with respect to one another axially of the drill, This means that the cutting edge 3*b* is subjected to load over its entire length in exactly the same way as the shorter cutting edge 13*b*. In this way, more even wear of the cutting inserts and more even drilling are obtained.

CLAIMS

1. A drilling tool for drilling holes in solid metal workpieces and comprising a shank and at least two exchangeable cutting inserts arranged in a recess at the front of the shank and each having a plurality of cutting edges of equal length, the cutting edge of at least one cutting insert being immediately adjacent the axis of the drill or extending slightly beyond it, the or at least two of the cutting inserts being of different sizes and being so arranged on the shank that their outer cutting corners are located at the same distance from the said axis.

2. A drilling tool according to claim 1, wherein the cutting inserts of different sizes are geometrically similar.

3. A drilling tool according to claim 1 or 2, wherein there are two cutting inserts and the cutting edges of the larger cutting insert extend inwards radially from the maximum radius of the drill at least as far as the said axis, and the cutting edges of the smaller cutting insert likewise extend inwards radially from the same maximum radius of the drill, but not as far as the said axis.

4. A drill tool according to any one of claims 1, 2 and 3, wherein the arrangement is such that the larger cutting insert has two front cutting edges which have a cutting action, and only the outer cutting edge of the smaller cutting insert has a cutting action.

5. A drilling tool according to any one of the preceding claims, wherein the cutting inserts are staggered axially with respect to one another in such manner that equal shaving cross-sections are covered by corresponding radially outer lengths of their cutting edges.

6. A drilling tool according to any one of the preceding claims, wherein the cutting inserts are so arranged on the shank of the drill

that, in a drilling operation, the outer front cutting edges define a common shallow cone having an obtuse angle of 120° to 170° and the apex of which coincides with the axis of the hole or of rotation of the drilling tool.

7. A drilling tool according to any one of the preceding claims, wherein each of the cutting inserts is hexagonal, the two adjacent cutting edges enclosing an angle of substantially 156° with each other at every second corner, and each of the two operative cutting edges encloses an angle of about 78° with a line parallel to the drilling axis.

8. A drilling tool according to claim 6, whrein the obtuse angle is 156° plus or minus 10°.

9. A drilling tool substantially as described hereinbefore with reference to and as shown in Figs. 1, 2, 3 and 5 of the accompanying drawings.

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